A SUMMARY OF INFORMATION RELATED TO THE COMPREHENSIVE MANAGEMENT OF GROUNDWATER RESOURCES IN MADISON, MONROE, AND ST. CLAIR COUNTIES, ILLINOIS

By

SOUTHWESTERN ILLINOIS METROPOLITAN
AND REGIONAL PLANNING COMMISSION

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I. INTRODUCTION

Groundwater is a vitally important natural resource that, until recent years, has been taken for granted and given little protection. Natural underground reservoirs (aquifers) vary greatly in the quantity of water available for use. Where present and capable of supplying water they have many advantages over surface water sources. They are readily available for storing water without any expenditures for construction purposes. They have large capacities and don't become clogged with silt and weeds as do lakes. Relatively inexpensive to tap, underground reservoirs lose little or no water by evaporation, they can supply water over large areas without the necessity of building canals, pipelines, or distribution systems; and, if properly managed, their period of usefulness has no foreseeable limit for all practical purposes.

Dependability is another major benefit of groundwater as a source of supply. Droughts and dry spells that lower levels in streams and lakes seldom have any substantial impact on groundwater reservoirs. Even though natural recharge through the soil is reduced or even halted during such periods, large amounts of water are usually present in the groundwater bank, where they serve as a reserve to tide the well owner over until the rains come again. In addition, because groundwater is insulated and protected below the surface of the earth, it is usually far less subject to contamination and pollution than the water in rivers and lakes.

Despite the fact that most groundwater aquifers have a natural protective barrier, instances of contamination of groundwater used for public and private drinking water supplies have been reported throughout the country. The critical aspect of groundwater pollution is that, once contaminated it may be decades before it can be used due to its very slow movement and limited mixing. Unlike surface water, groundwater quality cannot be "corrected" by applying pollution control measures after the pollution has occurred. Cleanup is difficult and costly -- sometimes impossible. In addition, monitoring groundwater quality is a difficult task. Not only because wells must be dug, but because the lack of mixing in an aquifer dictates that several samples from different locations and levels are needed to get an accurate picture of groundwater quality in an area.

Uses of Groundwater in Madison, St. Clair and Monroe Counties

Groundwater has become valuable as a water source throughout the three-county area, serving as a supply for public, industrial, domestic and agricultural uses. The area's major aquifers are located in the American Bottoms (also known as the Mississippi River flood plain), the lowland area which lies between the Mississippi River and the bluffs along the western edge of the study region. In addition to being the area's largest

groundwater source, it is also the location of major concentrations of urbanization and industrialization.

Within the three counties, thirty-three (33) separate public water supply systems obtain water from ground sources. Twenty (20) of these systems are for municipalities (see Table 1) while the remaining thirteen (13) systems supply areas such as mobile home parks, schools, and industry. These twenty systems use approximately 10.3 million gallons per day (mgd) to supply an estimated 120,919 persons. The largest withdrawals are made in the American Bottoms area to serve the larger population in that area with the smaller withdrawals being made for the communities in the eastern section of the upland.

Industry is a major user of groundwater in the American Bottoms (see Chapter III). Although industrial pumpage has decreased in recent years it still serves as a valuable resource. A major advantage of groundwater is that it maintains an almost constant temperature throughout the year. Industries, as a result, are able to utilize the groundwater for cooling water during the summer months when the Mississippi River water is warm. In addition, the cost of treating the groundwater is lower than treating Mississippi River water which is heavily laden with sediment and chemicals.

Groundwater is also used for domestic and irrigation purposes but in relatively small amounts. For most rural areas, however, groundwater represents the only economical source of water. Rural water users are greatly dispersed. It would be economically prohibitive to design and develop a water system which could supply relatively few users over an extensive area. Therefore, rural residents are often totally dependent upon groundwater. Groundwater for irrigation accounts for a very small portion of total groundwater usage, approximately one percent. Most of the irrigation wells are located in the American Bottoms and are used primarily to irrigate horseradish and truck crops. The amount of groundwater pumped depends in large part on climatic conditions. In years with significantly below normal precipitation there is a substantial increase in the amount of groundwater pumpage.

The potential for polluting groundwater is high in many portions of the study area. This is particularly true within the American Bottoms and major flood plains throughout the region. Within these lowland areas, groundwater levels are generally high and therefore more susceptible to pollution from solid and liquid waste disposal. Major sources of potential groundwater pollution within the three-county area are identified in the following chapters.

Purpose and Scope

The purpose of this report is to summarize and interpret available information related to groundwater occurrence, movement, availability, use,

Table 1

LOCATION OF GROUNDWATER SOURCES FOR COMMUNITIES
OF MADISON, ST. CLAIR AND MONROE COUNTIES

Community	Estimated Population Served	Average Daily Withdrawals (MGD)	Location of Groundwater Source	
			American Bottoms	Other Than the American Bottoms
MADISON COUNTY:				
Alhambra	825	0.060		X
Bethalto	18,239	1.380		X
Collinsville	23,698	2.150	X	
East Alton	7,800	0.650	X	
Edwardsville	26,993	1.790	X	
Glen Carbon	5,310	0.530	X	
Hamel	600	0.059		X
Hartford	1,680	0.360	X	
Holiday (MHP)	600	0.027	X	
Livingston	967	0.057		X
Marine	1,004	0.074		X
Maryville	3,393	0.299	X	
Roxana	3,886	0.580	X	
St. Jacob	862	0.057		X
Troy	9,245	0.681	X	
Wood River	13,500	1.327	X	
Worden	950	0.060		X
Subtotal	119,552	10.141		
ST. CLAIR COUNTY:				
Fayetteville	380	0.024		X
Mounds (PWD)	2,200	0.108	X	
St. Libory	550	0.057		X
Subtotal	3,130	0.189		
MONROE COUNTY:				
Valmeyer	900	0.075		X
Maeystown	137	0.011		X
Maple Leaf Estates	42	0.005		X
Timber Lake Estates	75	0.005		X
Subtotal	1,154	0.096		
TOTAL	123,836	10.426		

Source: IEPA, Division of Public Water Supplies,
Collinsville Field Office, 1983.

and quality in the three counties of Madison, St. Clair, and Monroe. It intends to provide basic technical information needed for the development of a regional strategy for the comprehensive, long-term management of the area's groundwater resource and to identify present or potential problem areas with respect to its use and/or quality.

A major task in this project was the preparation of maps to assist the reader in identifying, understanding and evaluating groundwater resources within the three counties. To accomplish this task, maps were obtained from previous publications and agencies or were prepared from available information. A total of twenty-seven (27) maps, at a scale of 1:433,520 are included in this report. In addition a transparent base map overlay showing municipalities, transportation lines and streams is provided in a pocket attached to the inside of the back cover.

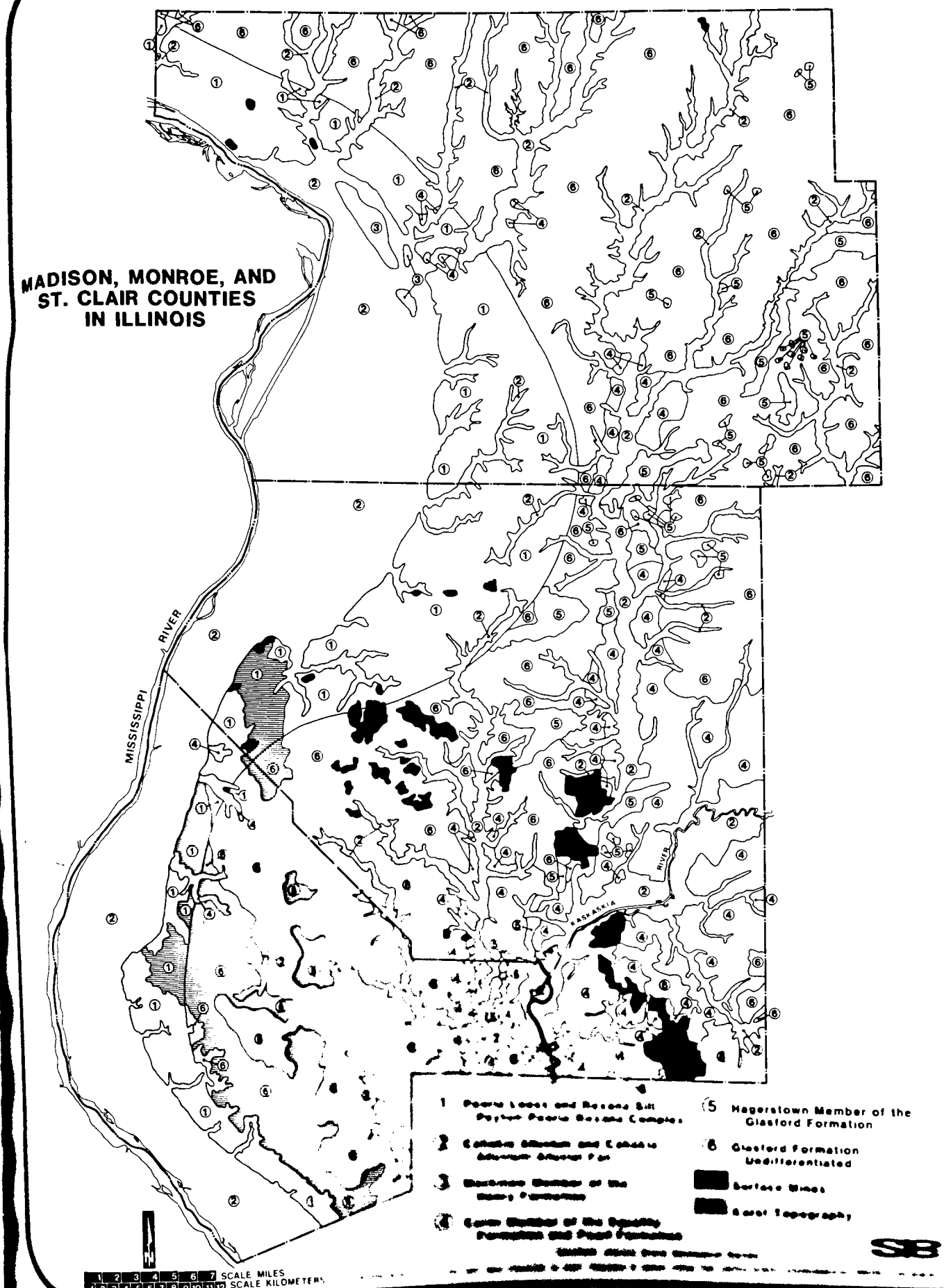
The organization and development of this report is based on the Sangamon River Basin Methodology developed by the Illinois State Water Survey (ISWS) for the Illinois Environmental Protection Agency (IEPA). Information essential to this report was provided by the ISWS as well as other state and local agencies including the IEPA and the Illinois State Geological Survey.

permeability and consist mainly of shales, sandstone, thin limestone and coal. The water-yielding character of these formations is variable but generally very low. The only formations that yield any appreciable amounts of water in these rocks are the sandstones. Because the sandstones differ laterally in permeability, they are not water-yielding at all sites. The chances of obtaining a well in the Pennsylvanian aquifers yielding more than 20 gpm are poor (see Figure 4). In addition, as the depth of the aquifer increases the water's mineral content also increases. As a result, the use of groundwater from these formations is extremely limited. Locally, however, shallow sandstone and creviced limestone may yield small supplies of groundwater in areas where drift supplies are inadequate.

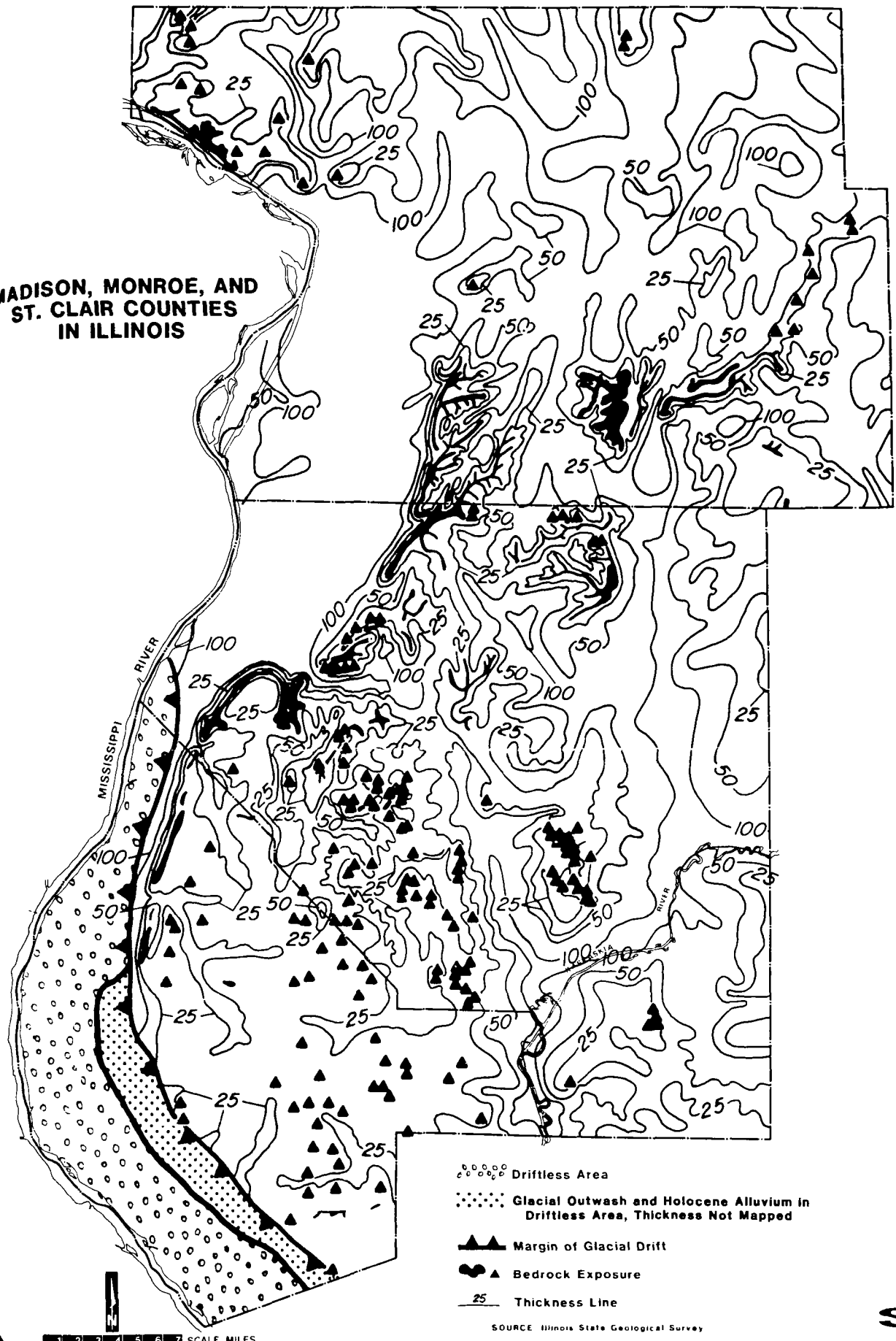
Unconsolidated Deposits - The glacial drift, ranging in thickness from 5 to 200 feet, which blankets the bedrock in Southwestern Illinois, was deposited during the Pleistocene Epoch. This later period in geologic history, which is often referred to as the Ice Age, began about one million years ago and was marked by the advance of continental glaciation. Although four major glacial advances covered portions of Illinois, glacial materials in the study area represent deposits left by only the last two advances -- the Illinoian and the Wisconsinan. The Illinoian Till Plain comprises much of the area east of the Mississippi River bluffs. Wisconsinan till is not present within the study area due to the fact that the Wisconsinan ice sheet did not advance into the study area. However, the effects of Wisconsinan glaciation within the study area are extremely widespread in the form of wind and water transported glacial materials. Melting glaciers deposited sand, gravel, silt and clay. After the flooding glacial meltwaters had receded, the glacial materials which had been deposited in the stream valleys became exposed. When these materials had dried, the wind picked up many of the fine-grained sand, silt and clay (mostly silt) sediments and deposited them on the uplands in uniform layers known as loess. Since winds were generally from the northwest, the loess deposits are thicker on the uplands adjacent to the Mississippi River flood plain. The distribution of the surficial materials is shown in Figure 5. The thickness of the glacial drift, which is identified in Figure 6, is highly variable. One hundred plus-foot thicknesses occur in the buried bedrock valley beneath the Kaskaskia River in eastern Monroe and St. Clair Counties as well as the Mississippi River. This drift and exposed bedrock are common in the upland area.

A majority of the available groundwater found in the study area is taken from valley fill materials. Most of the groundwater from valley fill material is withdrawn from the flood plain of the Mississippi and Kaskaskia Rivers. The probabilities for obtaining high yield wells for industrial and municipal uses are favorable in these areas (see Figure 7). High capacity wells reach excellent water yielding sand and gravel deposits at depths of 50 to 75 feet.

Generalized Distribution of Quaternary Deposits



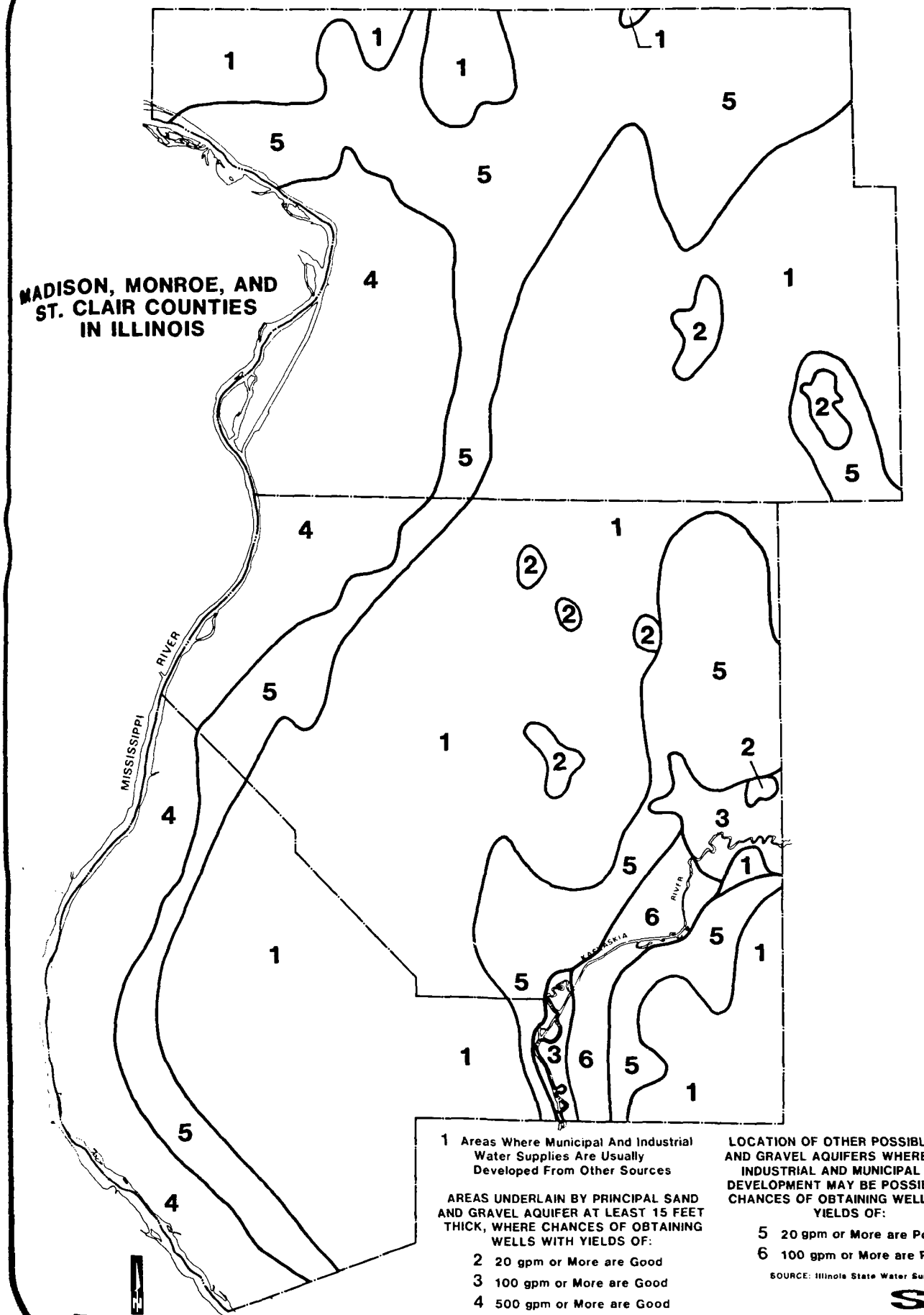
Thickness of the Glacial Drift



SOURCE Illinois State Geological Survey

THE PREPARATION OF THIS MAP WAS FINANCED IN PART THROUGH A GRANT FROM THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Estimated Yields of Wells in Sand and Gravel Aquifers



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The Mississippi River flood plain is the dominant source of groundwater recovered from valley fill materials. The valley fill is composed of recent alluvium and glacial valley train material and is underlain by Mississippian and Pennsylvanian bedrock, consisting of limestone and dolomite with subordinate amounts of sandstone and shale. It has an average thickness of 120 feet and ranges in thickness from less than one foot near the bluffs to over 170 feet near the City of Wood River. The valley fill is generally at its greatest thickness at a mid-point between the bluffs and the river. The coarsest deposits most favorable for water development are commonly encountered near bedrock and often average 30 to 40 feet in thickness. Recharge within the area is from precipitation, induced infiltration of surface water from the Mississippi River and small streams traversing the area, and subsurface flow from the bluffs bordering the area.

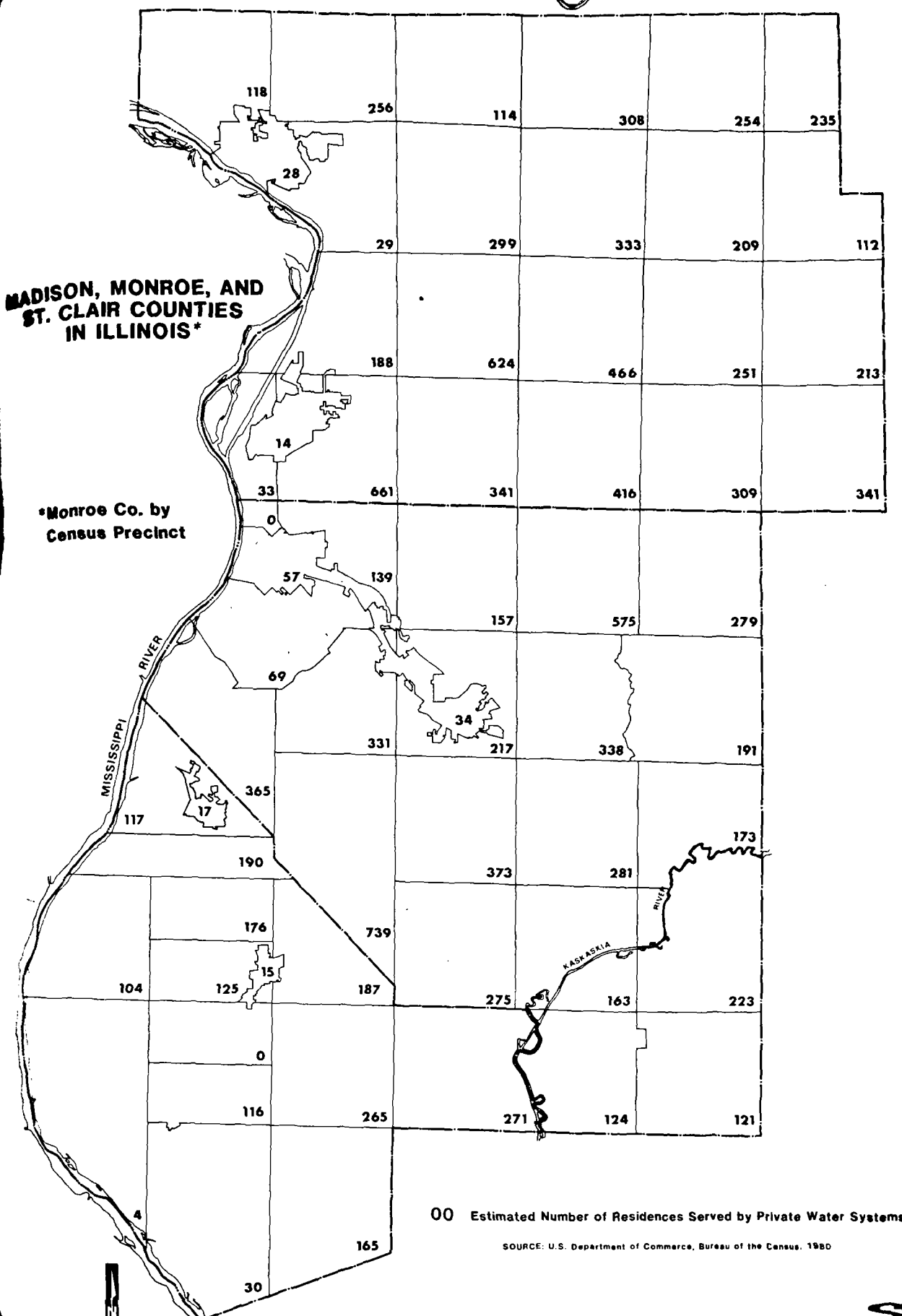
Groundwater Flow - The direction of groundwater flow is ideally determined from the collection and interpretation of regional water data. This data exists only for the sand and gravel aquifers in the American Bottoms. Only very limited data is available on other aquifers within the study area. The Illinois State Water Survey currently operates a network of 15 groundwater level observation wells in the study area, all of which are in the East St. Louis area. Figure 8 shows their location and Table 2 summarizes the types and periods of record for the water-level data.

Generally throughout the study area groundwater movement in the shallow drift deposits follows the land surface topography, with lateral movement toward local discharge zones (small streams and wells) and some movement into the deeper unconsolidated aquifers. Groundwater in the deeper drift deposits generally follows the bedrock surface. As a result, groundwater generally moves "downstream" through the sand and gravel aquifers in much the same direction as the original streamflow, but at a much slower rate.

Groundwater in the East St. Louis area generally moves slowly towards the west southwest to the Mississippi River and other streams and towards cones of depression created by industries and municipalities. The establishment of industrial centers and the subsequent use of large quantities of groundwater by industries and municipalities has lowered water levels appreciably in the areas of heavy pumping. Historically, the lowering of water levels in the major pumping centers along the Mississippi River has established hydraulic gradients from the Mississippi toward the pumping centers. At times groundwater levels are below the surface of the river at places, diverting appreciable quantities of water from the river into the aquifer by inducing infiltration.

Groundwater Levels - High groundwater levels are a major problem associated with the unconsolidated aquifer located in the Mississippi River flood plain, in particular the East St. Louis area. Contributing to the problem is the fact that groundwater levels in this area have steadily risen since

Estimated Number of Residences Served by Private Water Systems



00 Estimated Number of Residences Served by Private Water Systems

SOURCE: U.S. Department of Commerce, Bureau of the Census, 1980

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V. AQUIFER SUSCEPTIBILITY TO CONTAMINATION

Numerous attempts have been made to develop standard methods for determining the degree of threat to groundwater quality posed by various potential pollution sources. These attempts have been hindered by the large number of complex factors involved in making a determination of this type and by the site-specific nature of many of these factors. Among these factors are: the nature of the potential source or cause of pollution; the nature and amount of the contaminants likely to be released by the source; the hydraulic and geochemical characteristics of the solid materials through which the contaminants must pass; the thickness of the unsaturated zone between the source and the aquifer; the rates and directions of flow within the aquifer; the location of the source with respect to groundwater recharge and discharge zones; the presence of natural or artificial conduits through which groundwater can rapidly flow; and, the baseline quality of the threatened aquifer.[1]

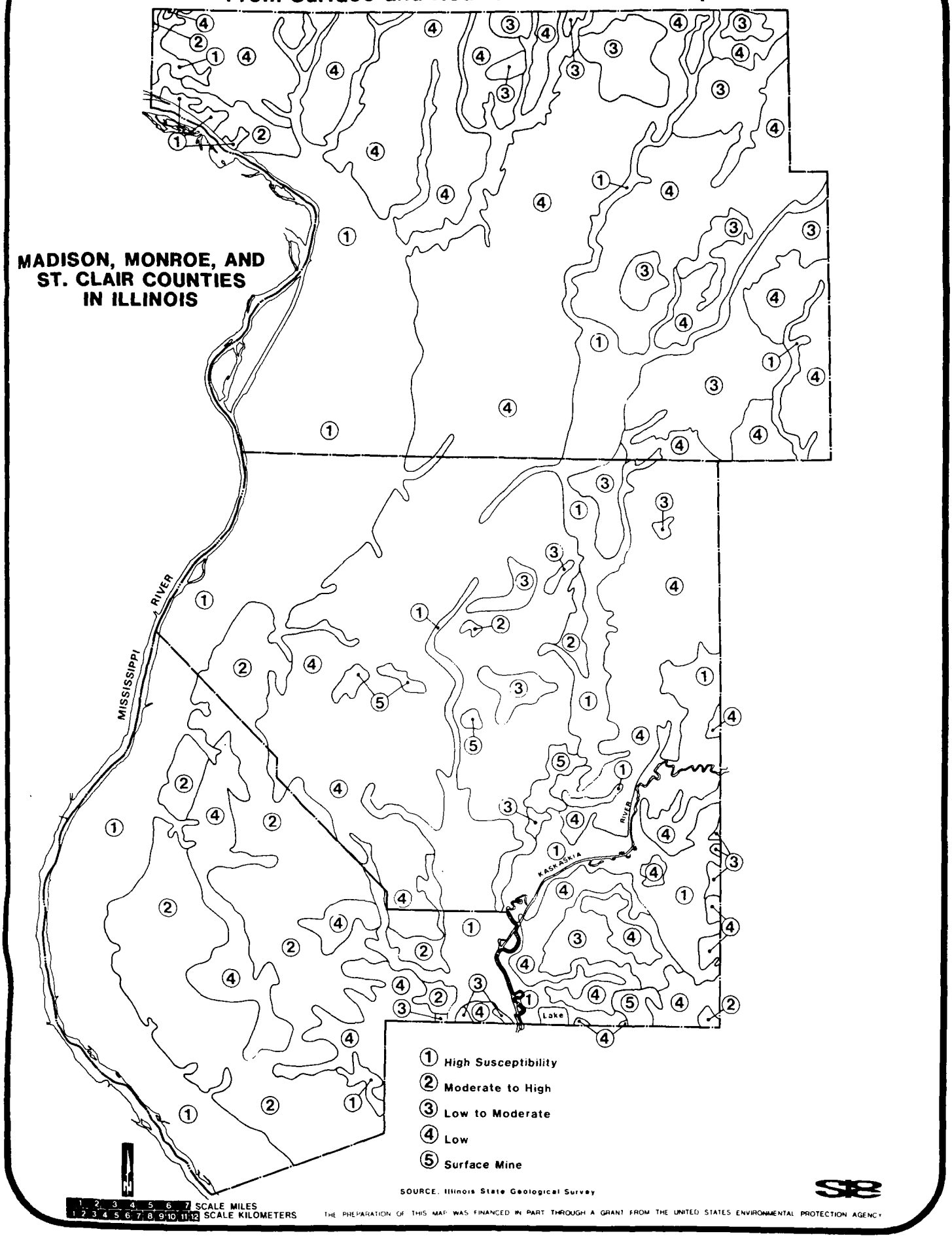
Some of these features, for example the geologic setting, are amenable to the construction of large scale maps that can simplify the determination of pollution potential. The Illinois State Geological Survey recently developed the capability to define subsurface geology in three dimensions (called "stack unit" mapping) and constructed statewide maps showing the relative susceptibility of shallow aquifers (at least 5 feet thick) to contamination. These maps are useful for assessing the degree of threat to shallow aquifers (within 50 feet of the land surface) to contamination by individual septic tank systems, surface spreading of wastes, and over-application of agricultural chemicals. The map available for Madison, Monroe, and St. Clair Counties is presented in Figure 17. A similar map is presented in Figure 18 to represent the susceptibility of shallow aquifers to the land burial of non-hazardous wastes. Both maps have been modified slightly to indicate the susceptibility category assigned by the geologists to the near-surface geologic conditions. Under no circumstances should the maps be used for site-specific locational studies, but rather as a guide to general planning and evaluation of existing disposal areas and selection of areas for new sites.

Surface/Near Surface Waste Disposal - Shallow Aquifers

Figure 17 shows susceptibility of shallow aquifers to contamination from septic tank systems and surface spreading of wastes and agricultural chemicals. Those areas most susceptible to contamination are alluvial or have thick sand and gravel at or near the surface and include the American Bottoms area, the Kaskaskia alluvium, and alluvial valleys of smaller

[1] Illinois State Water Survey - Sangamon River Basin Study.

Susceptibility of Shallow Aquifers to Contamination From Surface and Near Surface Waste Disposal



SOURCE: Illinois State Geological Survey

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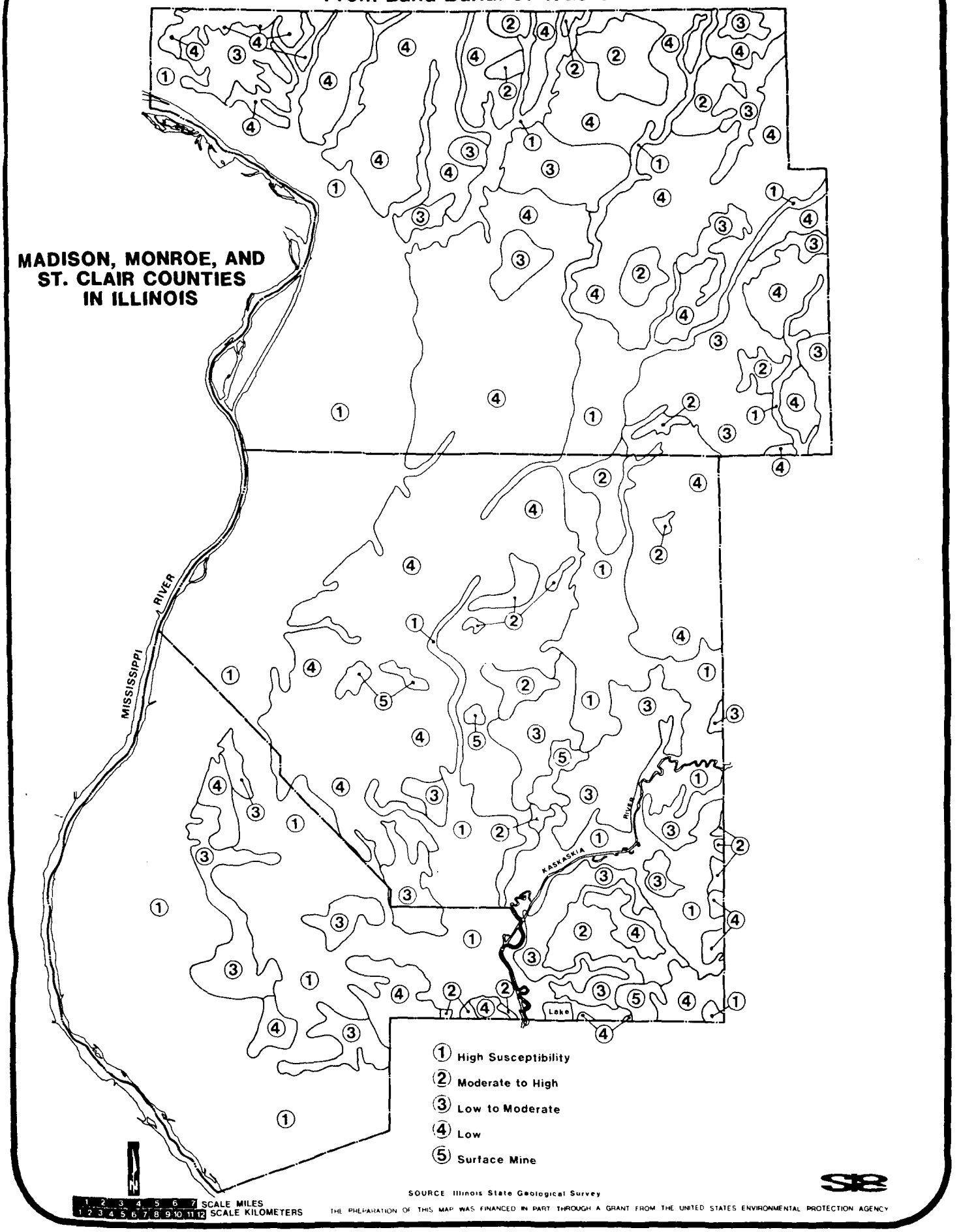
Susceptibility of Shallow Aquifers to Contamination From Land Burial of Wastes



SOURCE Illinois State Geological Survey

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streams in the region. Areas with moderate to high susceptibility have permeable bedrock generally between 5 and 20 feet of the surface and include the large area of Karst in Monroe County and small areas in Madison and St. Clair Counties. Areas with low to moderate susceptibility have shallow sands and gravels within 20 feet of the surface which are overlain and underlain by relatively impermeable till, other fine-grained material or bedrock. These areas are located in eastern Madison and St. Clair Counties. Areas with the least susceptibility to contamination by surface/near-surface waste disposal have a minimum of 20 feet of uniform till or other fine-grained material at the surface or have relatively impermeable bedrock within 20 feet of the surface, mostly overlain by till or other fine-grained material. These areas are found througout most of the uplands in Madison and St. Clair Counties.

While this classification categorizes materials according to susceptibility to potential contamination, it also rates the materials generally according to potential problems that may limit the operational effectiveness of shallow waste disposal systems and methods. Those materials most highly susceptible to contamination will generally let waste effluent enter easily, and shallow treatment systems, such as a septic system, appear to operate well. The materials least susceptible to contamination, because of low hydraulic conductivities, often do not readily accept waste; acceptance problems may cause septic system failure. The density of septic system units or frequency of application of agricultural chemicals or sewage sludge, topographic considerations and surface soil characteristics may also affect the optimum workability of surface and near-surface waste disposal and their potential to contaminate ground and surface waters. Local soils maps as well as detailed geologic information are often necessary for proper management of this type of waste disposal.[2]

Land Burial of Municipal Wastes - Shallow Aquifers

Figure 18 shows susceptibility of shallow aquifers to contamination by municipal waste disposal by land burial. Those areas most susceptible to contamination are alluvial or have sand and gravel or permeable bedrock within 20 feet of the land surface, and include the American Bottoms area, the Karst area in Monroe County, the Kaskaskia alluvium, and alluvial valleys of smaller streams in the region.

Areas with moderate to high susceptibility have sand and gravel deposits within 20 feet of the surface, overlain and underlain by relatively impermeable till, other fine-grained material, and/or bedrock. These areas are located in eastern Madison and St. Clair Counties.

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[2] Illinois State Geological Survey. Potential for Contamination of Shallow Aquifers in Illinois.